

Kinetic Inductance Detector Arrays for Far-IR Astrophysics

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Description and Objectives:

- Half of the electromagnetic energy emitted since the big bang lies in the far-infrared. Large-format far-infrared imaging arrays are needed for studying galaxy formation and evolution, and star formation in our galaxy and nearby galaxies. Polarization-sensitive arrays can provide critical information on the role of magnetic fields.
- We will develop and demonstrate far-IR arrays for these applications.

Key Challenge/Innovation:

- Far-infrared arrays are in high demand but are difficult to fabricate, and therefore expensive and in short supply. Our solution is to use titanium nitride (TiN) absorber-coupled, frequency-multiplexed kinetic inductance detectors.

Approach:

- The goal is to raise the TRL of these detectors so that investigators may confidently propose them for a variety of instruments:
 - Ground telescope demo, 350 mm, $3 \times 10^{-16} \text{ W Hz}^{-1/2}$
 - Lab demo for SOFIA, 90 mm, $1.7 \times 10^{-16} \text{ W Hz}^{-1/2}$
 - Lab demo for balloon, 350 mm, $7 \times 10^{-17} \text{ W Hz}^{-1/2}$
 - Lab demo for space, 90 mm, $5 \times 10^{-19} \text{ W Hz}^{-1/2}$

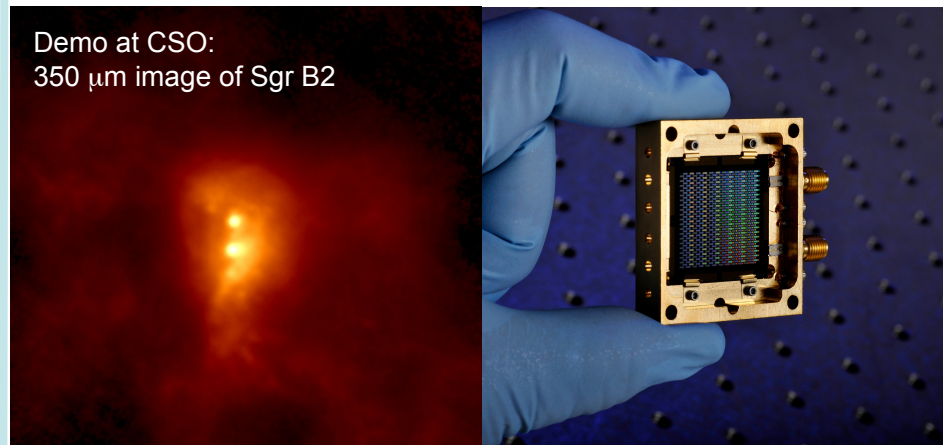
Key Collaborators:

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|-------------------------|---------------------------|
| • G. Chattopadhyay, JPL | • Matt Hollister, Caltech |
| • Peter Day, JPL | • Rick Leduc, JPL |
| • Darren Dowell, JPL | • Chris McKenney, Caltech |

Development Period:

- Jan 2013 – Dec 2014

Demo at CSO:
350 μm image of Sgr B2



Accomplishments and Next Milestones:

- Fall 2012: Lab demonstration at 350 μm
- Spring 2013: Successful 350 μm telescope demo at the Caltech Submillimeter Observatory (CSO) (see image above)
- Summer 2013: Lab tests of 350 μm lens-coupled arrays
- Fall 2013: First lab tests of high-sensitivity arrays

Application:

- SOFIA instruments
- Balloon payloads
- Future space mission, e.g., SAFIR/CALISTO
- Ground-based telescopes
- Applicable to both cameras and spectrometers (low NEP lab demo)
- Potential impact on mm-wave CMB instrumentation

TRL_{in} = 3 TRL_{current} = 3 TRL_{target} = 4-6